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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/599,783	06/22/2000	Toshiharu Furukawa	BU9-99-197	7947

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S Jared Pitts
Schmeiser Olsen & Watts
18 East University Dr #101
Mesa, AZ 85201

EXAMINER
MALDONADO, JULIO J

ART UNIT	PAPER NUMBER
2823	

DATE MAILED: 03/13/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/599,783	FURUKAWA ET AL.	
	Examiner	Art Unit	
	Julio J. Maldonado	2823	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondenc address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *31 December 2001* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-32* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-32* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 1, 9, 15, 24 and 31 are rejected under 35 U.S.C. 103(a) as being unpatentable over Angelopoulos et al. (U.S. 6,316,167), Cho et al. (U.S. 6,074,930) and Juengling (U.S. 5,750,442).

In reference to claims 1, 9, 15, 24 and 31 Angelopoulos et al. (Fig.10) teaches a lithographic process including the steps of depositing a resist film comprising germanium (R:C:H:X) over a dielectric layer (nitride); depositing a photo resist layer over the germanium layer; patterning the germanium layer through the photo resist layer to form a germanium hard mask as a top most layer over the dielectric layer; selectively etching the dielectric layer forming a dielectric hard mask through the germanium hard mask with the germanium hard mask as a top most layer to form an opening in the dielectric layer; and selectively etching the semiconductor substrate through the opening in the dielectric layer; and removing the photo resist layer.

However, Angelopoulos et al. do not teach depositing a dielectric stack prior to the formation of the germanium layer, forming doped regions in the

semiconductor substrate, nor forming dielectric and conductive structures over the semiconductor substrate. Nevertheless, Cho et al. (Fig.4-12) teaches in an analogous method the steps of forming a dielectric stack (32, 34, 36) over a major surface of a semiconductor substrate (30); selectively etching the dielectric stack (32, 34, 36) forming a dielectric hard mask; and etching the semiconductor substrate through the dielectric hard mask. Furthermore, Cho et al. relates the method disclosed therein towards the use of trenches used to isolate devices in CMOS and bipolar circuits (column 1, lines 10-41).

It would have been obvious to one skilled in the art to incorporate the teachings of Cho et al. into those of Angelopoulos et al. for an expectation of success. The motivation/suggestion would be to utilize the dielectric stacks as an etching mask to form slots or trenches in a silicon substrate and thus to isolate devices in CMOS and bipolar circuits (column 1, lines 19-57).

However, Angelopoulos et al, in combination with Cho et al. does not teach the formation doped regions and forming conductive structures over the semiconductor substrate. It would have been obvious to one of ordinary skill in the art to include doped regions and conductive structures since the incorporation of such regions and structures is a well-known practice in the art.

Still, Angelopoulos et al. in combination with Cho et al. does not teach the steps of forming the patterning mask includes metallic germanium over the dielectric stack and patterning the metallic germanium to form a germanium hard mask. Nevertheless, Juengling shows (Fig.1-3), in an analogous art related to

the formation of semiconductor devices forming a dielectric layer (12, 14) over a major surface of a semiconductor substrate (10) and depositing a layer of metallic germanium (16) over the dielectric layer (12, 14).

It would have been obvious to one skilled in the art to combine the teachings of Angelopoulos (et al.), Cho et al. and Juengling to arrive the claimed invention. The motivation/suggestion would be to replace the germanium-containing layer (R:C:H:X) of Angelopoulos et al. with the metallic germanium of Juengling to improve photolithography control and facilitate the removal of the photoresist layer (column 1, line15 – column 2, line 58).

In reference to claims 2-8, 10-14, 16-21, 25-30 and 32 Angelopoulos et al. in combination with Cho et al. and Juengling teaches the step of stripping away the layer of metallic germanium by oxidizing the layer of metallic germanium to form a layer of germanium oxide and removing said oxide with a solution comprising hydrogen peroxide and sulfuric acid after performing the step of selectively etching the dielectric layer but prior to selectively etching the semiconductor substrate; depositing the layer of metallic germanium having a thickness between approximately 40 nm and approximately 500 nm in a CVD process; depositing a photo resist layer over germanium, developing and etching the layer of germanium through the pholithography image; and that the dielectric stack comprises forming a pad oxide over the major substrate of the semiconductor substrate, depositing a nitride layer over said pad oxide and depositing a mask oxide layer over said nitride layer.

However, Angelopoulos et al. in combination with Cho et al. and Juengling do not teach the step of rinsing the semiconductor substrate in water. It would have been obvious to one skilled in the art at the time the invention was made to remove the germanium oxide with water, since hydrogen peroxide of which the rinsing solution includes decomposes into water upon its application.

Still, Angelopoulos et al. in combination with Cho et al. and Juengling fails to teach forming the pad oxide to a thickness between 5 nm and 30 nm depositing the nitride layer to a thickness between 50 nm and 300 nm and depositing the mask oxide layer to a thickness between 800 nm and 3,000 nm.

It would have been obvious to one of ordinary skill in the art to include the above-mentioned dimensional thickness, since the selection of individual thicknesses of individual layers within a multilayered dielectric layer are well-known processing variables and the discovery of optimum ranges involves only routine skill in the art.

Allowable Subject Matter

3. Claims 22 and 23 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

4. The following is a statement of reasons for the indication of allowable subject matter.

The prior art of record, to Angelopoulos et al. teaches forming a resist film R:C:H:X, where R is germanium over a dielectric layer (nitride); depositing a

photo resist layer over the germanium layer; patterning the germanium layer through the photo resist layer to form a germanium hard mask as a top most layer over the dielectric layer; selectively etching the dielectric layer forming a dielectric hard mask through the germanium hard mask with the germanium hard mask as a top most layer to form an opening in the dielectric layer; and selectively etching the semiconductor substrate through the opening in the dielectric layer; and removing the photo resist layer.

However, Angelopoulos et al. neither teach nor suggest forming a layer of metallic germanium over a dielectric stack; removing the photoresist layer prior to selectively etching the dielectric layer through the germanium hard mask; and removing the photoresist layer through the germanium hard mask.

Conclusion

5. Papers related to this application may be submitted directly to Art Unit 2823 by facsimile transmission. Papers should be faxed to Art Unit 2823 via the Art Unit 2823 Fax Center located in Crystal Plaza 4, room 3C23. The faxing of such papers must conform to the notice published in the Official Gazette, 1096 OG 30 (15 November 1989). The Art Unit 2823 Fax Center number is **(703) 305-3432** . The Art Unit 2823 Fax Center is to be used only for papers related to Art Unit 2823 applications.

6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to **Julio J. Maldonado** at **(703) 306-0098** and between the hours of 8:00 AM to 4:00 PM (Eastern Standard Time) Monday

through Friday or by e-mail via julio.maldonado@uspto.gov. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy, can be reached on (703) 308-4918.

7. Any inquiry of a general nature or relating to the status of this application should be directed to the **Group 2800 Receptionist** at **(703) 308-0956**.

8. The following list is the Examiner's field of search for the present Office Action:

Field of Search	Date
U.S. Class / Subclass(es): 430/313, 438/424, 438/761	02/14/2002
Other Documentation:	
Electronic Database(s): EAST (USPAT)	02/14/2002

Julio J. Maldonado
Patent Examiner
Art Unit 2823
703-306-0098
julio.maldonado@uspto.gov

SUPERVISORY PRIMARY EXAMINER
TECHNOLOGY CENTER 2800